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(19) **United States**(12) **Patent Application Publication****Sahr et al.**(10) **Pub. No.: US 2010/0025893 A1**(43) **Pub. Date: Feb. 4, 2010**(54) **METHOD OF MANUFACTURING USING
RESIN TRANSFER MOLDING**(75) Inventors: **Ronald C. Sahr**, Randall, MN
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continuation of application No. 11/561,974, filed on
Nov. 21, 2006, now Pat. No. 7,373,896, which is a
continuation of application No. 11/288,646, filed on
Nov. 28, 2005, now Pat. No. 7,156,043, which is a
continuation of application No. 10/118,589, filed on
Apr. 8, 2002, now Pat. No. 6,994,051, which is a con-
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24, 1999.**Publication Classification**(51) **Int. Cl.**
B32B 37/10 (2006.01)(52) **U.S. Cl.** **264/510**(57) **ABSTRACT**

A method for molding an article having an upper portion, a lower portion, and an insert located between the upper portion and the lower portion, wherein the article is molded as a single, unitary piece with no seams or discontinuities located between the upper portion and the lower portion, includes providing a first semi-rigid membrane removably mounted to a first rigid housing to define a first fluid tight chamber therein, providing a mold plenum defined at least in part by the first semi-rigid membrane removably mounted to the first rigid housing, filling the first fluid tight chamber with a substantially non-compressible backing fluid to support the first semi-rigid membrane during injection of resin, positioning the insert in the mold plenum, providing fibrous reinforcing material within the mold plenum, the fibrous reinforcing material including portions positioned between the first semi-rigid membrane and the insert, the fibrous reinforcing material portions positioned between the first semi-rigid membrane and the insert being in contact with the insert, injecting resin under pressure into the mold plenum such that the resin envelops the fibrous reinforcing material and the insert, distributing a resulting injection pressure by the backing fluid, and curing the resin by heating the backing fluid to produce the molded article.

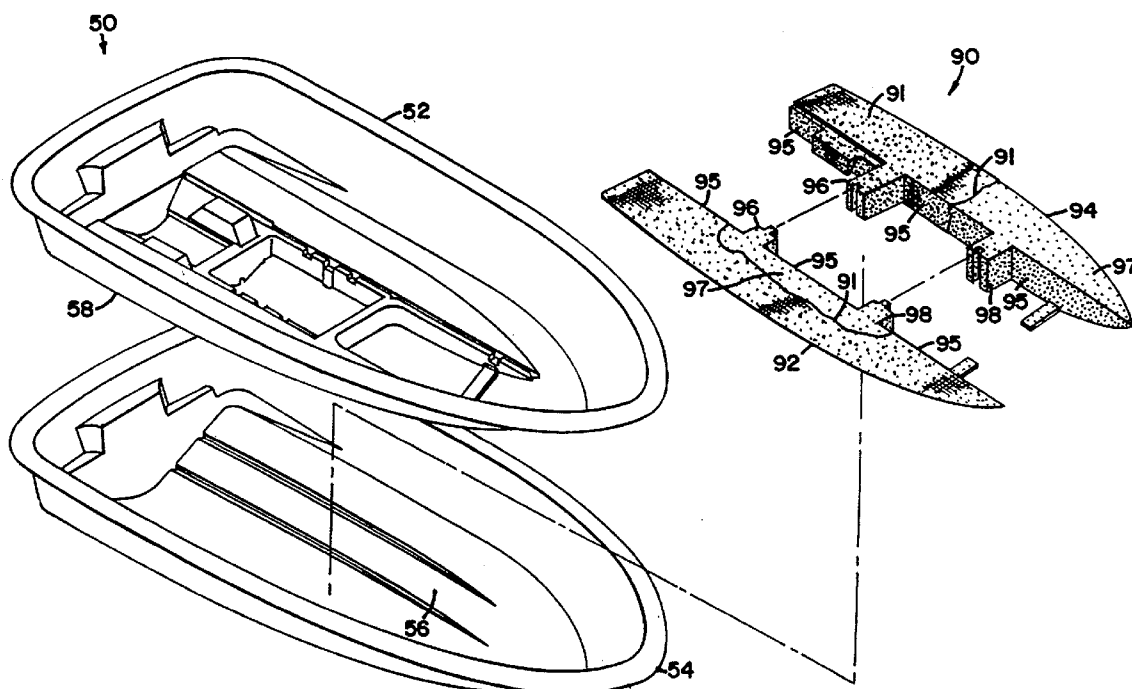


FIG. 1

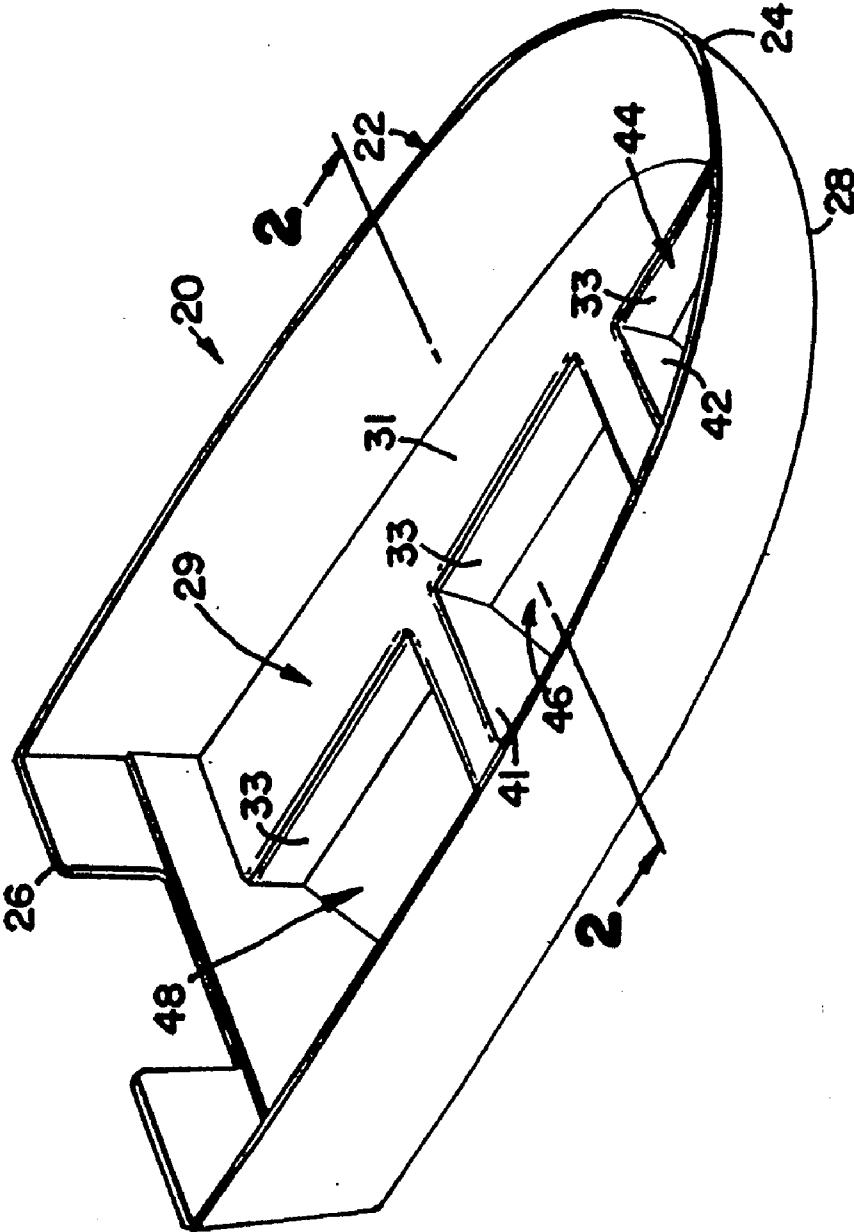


FIG. 2

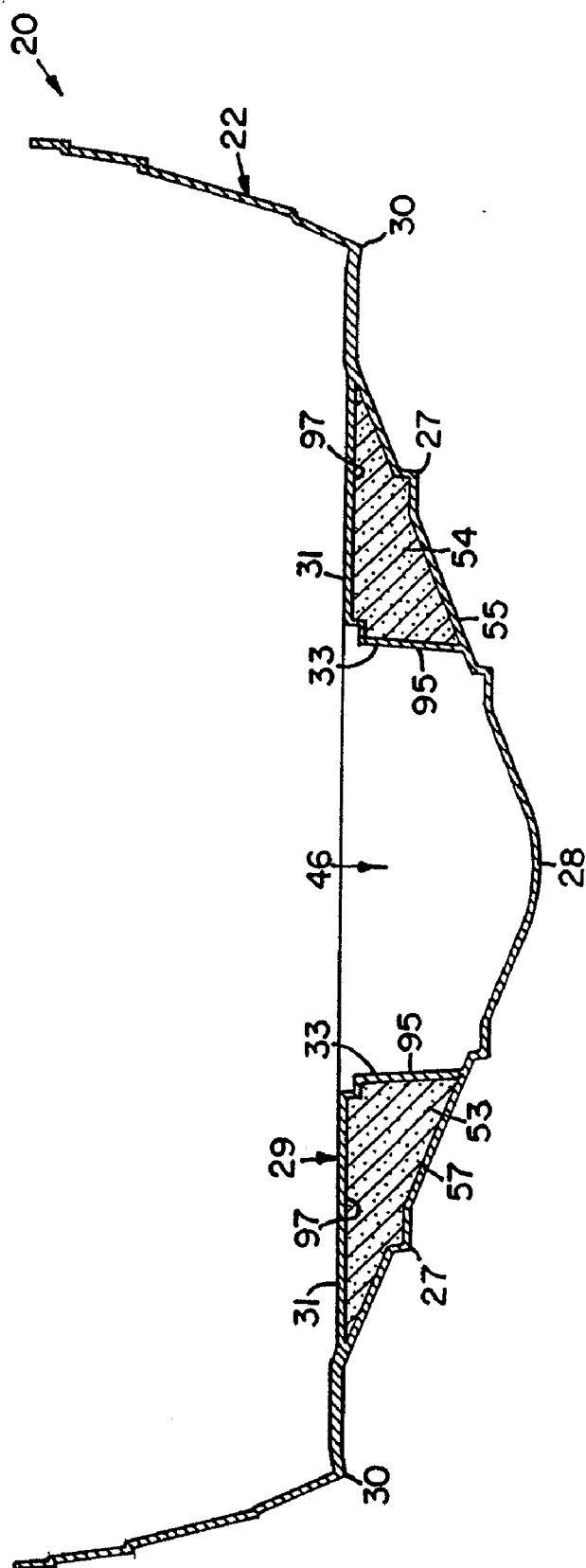
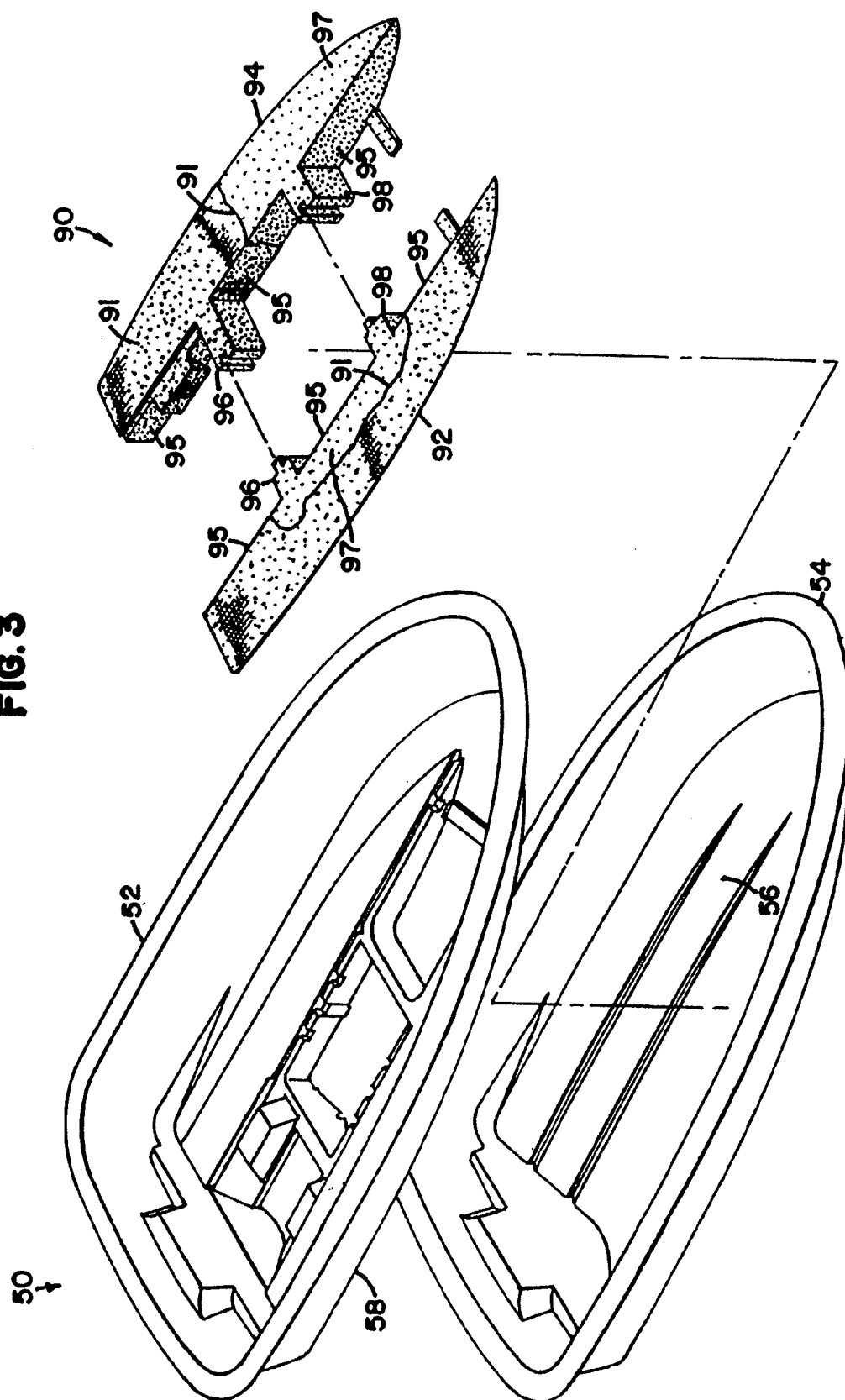


Fig. 3



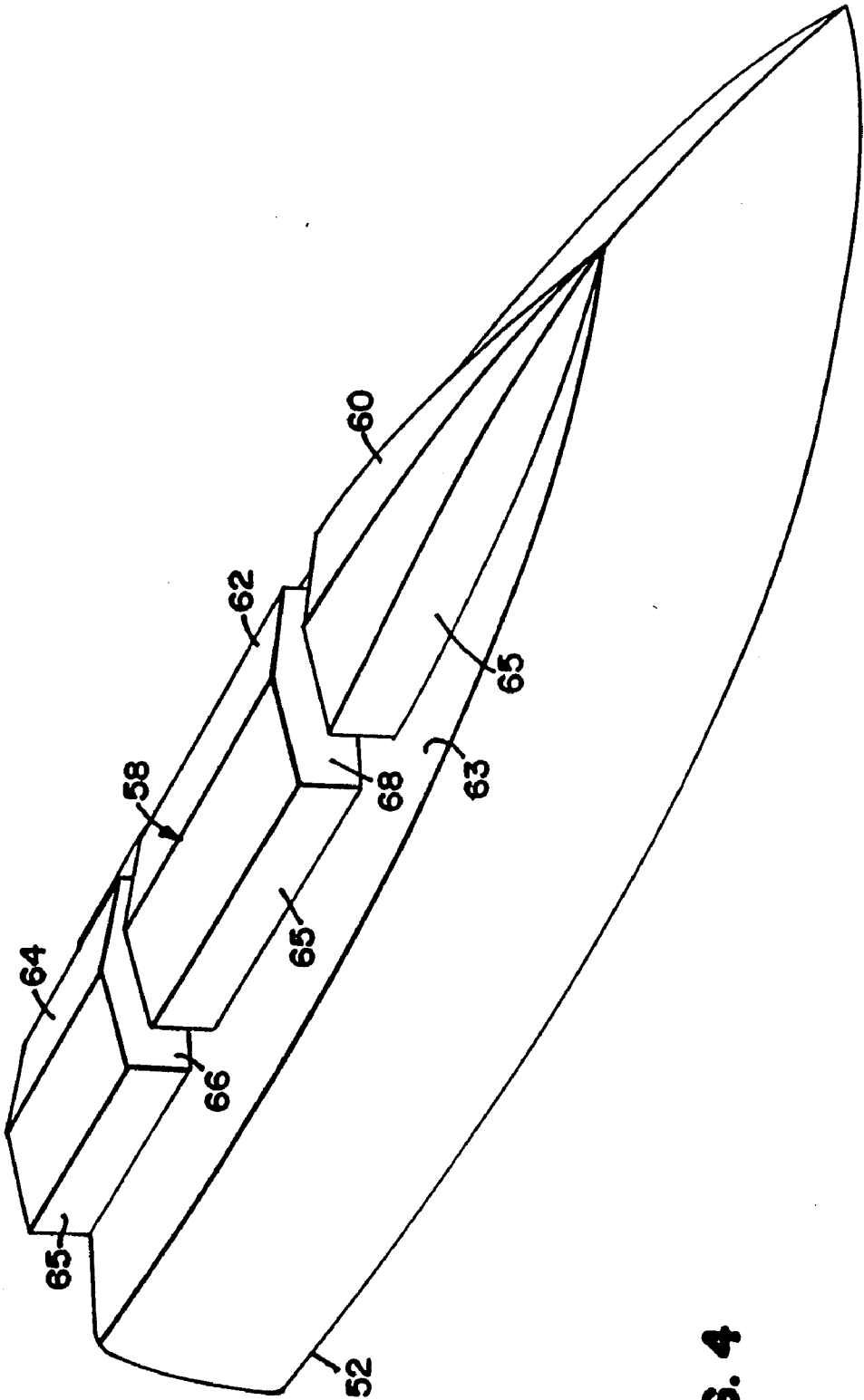


FIG. 4

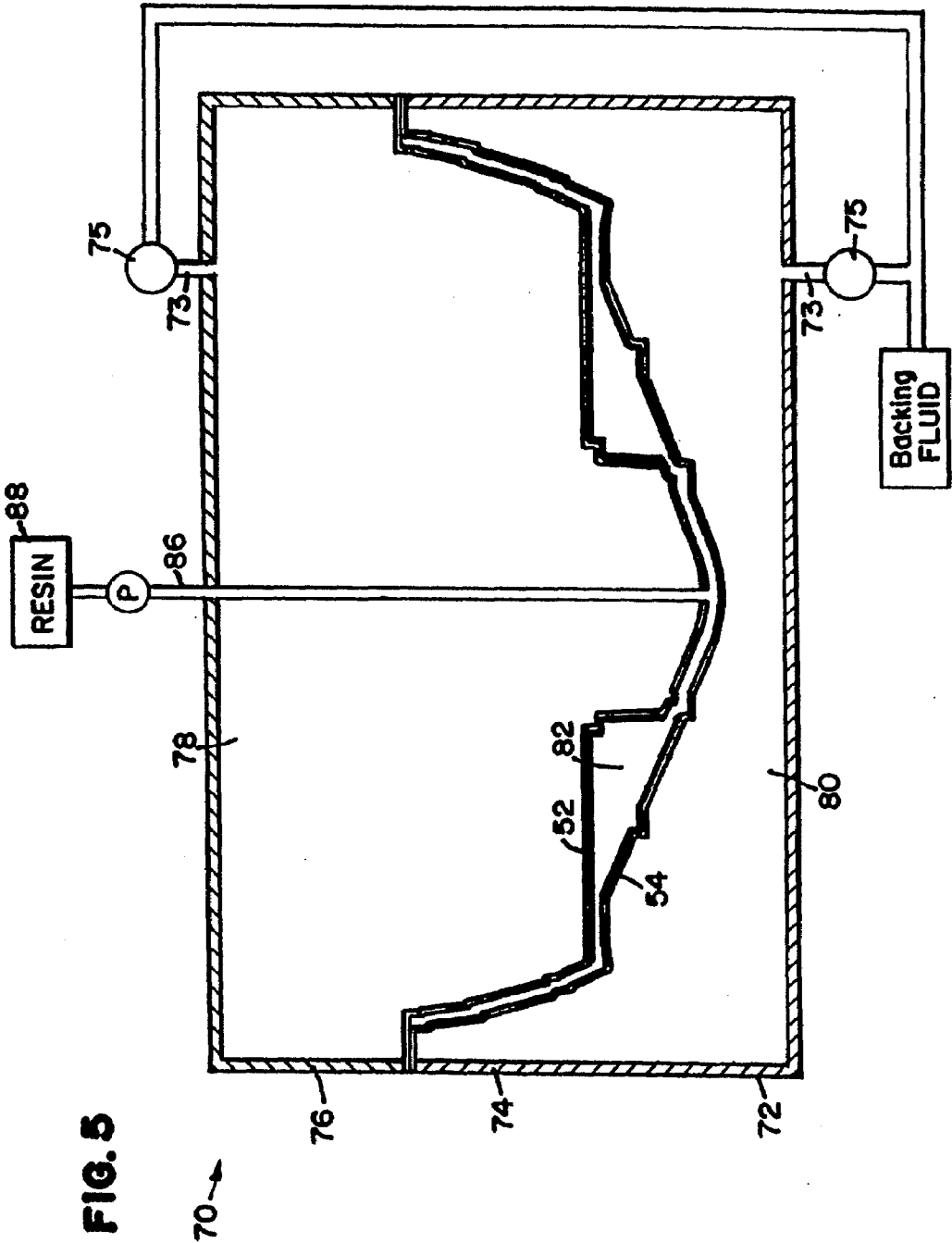
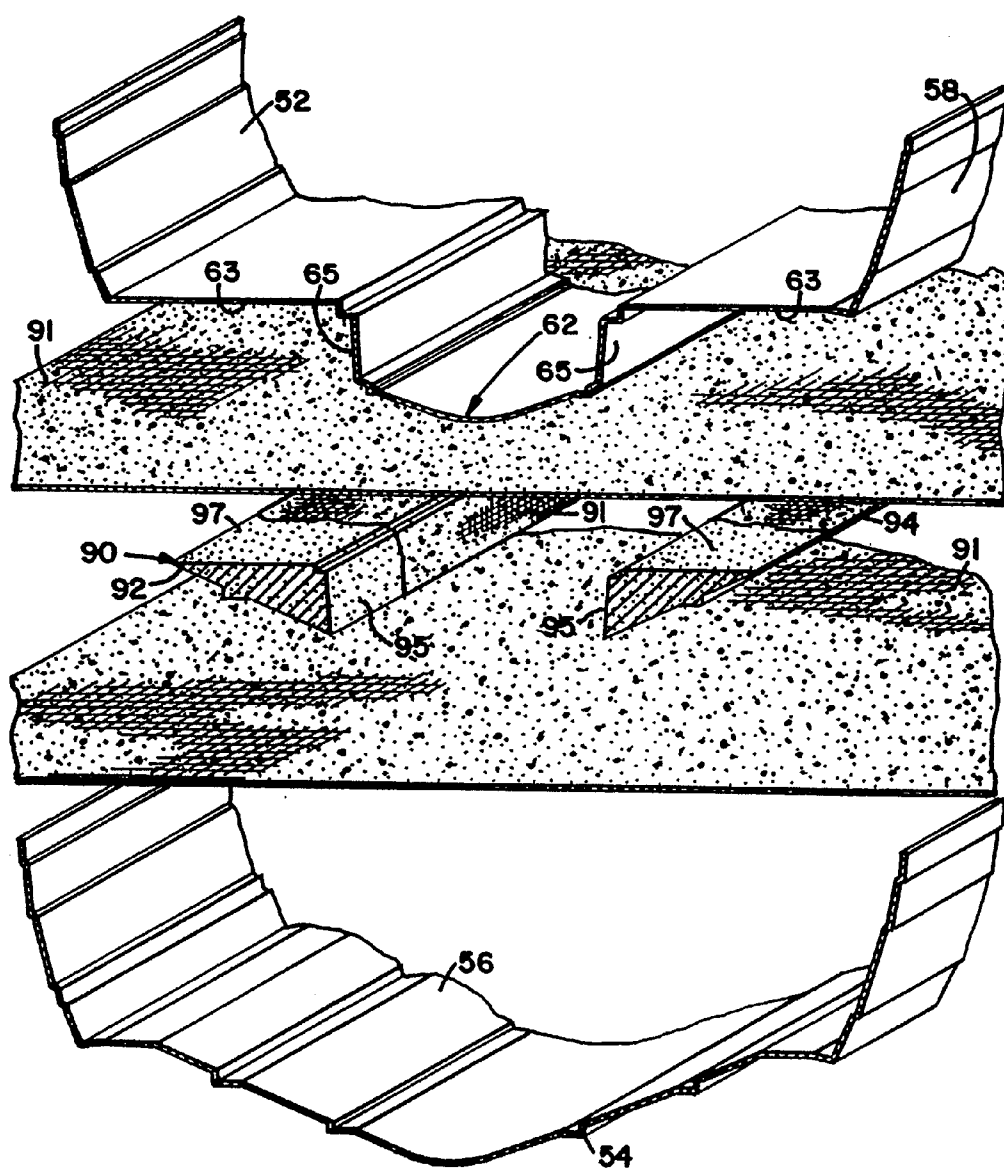


FIG. 6



METHOD OF MANUFACTURING USING RESIN TRANSFER MOLDING

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of application Ser. No. 12/123,627, filed May 20, 2008, which is a continuation of application Ser. No. 11/561,974, filed Nov. 21, 2006, now U.S. Pat. No. 7,373,896, which is a continuation of application Ser. No. 11/288,646, filed Nov. 28, 2005, now U.S. Pat. No. 7,156,043, which is a continuation of application Ser. No. 10/118,589, filed Apr. 8, 2002, now U.S. Pat. No. 6,994,051, which is a continuation of application Ser. No. 09/664,019, filed Sep. 19, 2000, now U.S. Pat. No. 6,367,406, which claims the benefit of U.S. Provisional Application Ser. No. 60/156,052, filed Sep. 24, 1999, which applications are incorporated herein by reference in their entirety.

FIELD OF THE INVENTION

[0002] The present invention relates generally to boats. More particularly, the present invention relates to boats having hulls with strengthened by fibrous reinforcing material and to methods for manufacturing such boats.

BACKGROUND OF THE INVENTION

[0003] Boat hulls have historically been made of many different types of material such as aluminum, steel or wood. Another common material used in the manufacture of boat hulls is a laminate material made of fiberglass-reinforced resin.

[0004] Open face molds are frequently used to manufacture fiberglass hulls. To make a hull with an open face mold, a layer of gel coat is frequently first applied to the mold. Next, a barrier layer is often applied to the gel coat. Finally a layer of fiberglass-reinforced resin is applied to the barrier layer. When the hull is removed from the mold, the gel coat provides a smooth, aesthetically pleasing outer surface of the hull. The barrier layer prevents the fiberglass from printing or pressing through the gel coat. The fiberglass provides the hull with structural rigidity. Additional rigidity is typically provided to the hull by stringer and flooring structures that are subsequently mounted within the hull.

[0005] Conventional techniques for manufacturing fiberglass boats involve a number of separate, time consuming process steps. What is needed is a more efficient process for manufacturing boats made of fibrous reinforcement material.

SUMMARY OF THE INVENTION

[0006] One aspect of the present invention relates to a method for making a boat. The boat includes a port side positioned opposite from a starboard side. The boat also includes a floor and stringers supports positioned within the hull. The method includes providing an insert having two spaced-apart elongated portions interconnected by at least two spaced-apart transverse portions that extend between the elongated portions. The elongated portions are sized and relatively positioned for one of the elongated portions to extend along the port side of the hull and the other of the elongated portions to extend along the starboard side of the hull. The method also includes positioning the insert in a chamber defined between a male mold piece and a female mold piece. The method further includes providing fibrous reinforcing material that surrounds the insert within the chamber. The

fibrous reinforcing material includes portions positioned between the male mold piece and the insert, and also includes portions positioned between the female mold piece and the insert. The method further includes transferring resin into the chamber between the male and female mold pieces such that the resin envelops the fibrous reinforcing material, and curing the resin within the chamber. As the resin cures, the resin enveloped fibrous reinforcing material hardens to form the hull, the floor and the support stringers of the boat.

[0007] A variety of advantages of the invention will be set forth in the description that follows, and in part will be apparent from the description, or may be learned by practicing the invention. It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate several aspects of the invention and together with the description, serve to explain the principles of the invention. A brief description of the drawings is as follows:

[0009] FIG. 1 is a perspective view of a boat constructed in accordance with the principles of the present invention;

[0010] FIG. 2 is a cross-sectional view taken along section line 2-2 of FIG. 1;

[0011] FIG. 3 illustrates a male mold piece, a female mold piece and a pre-formed insert adapted to be positioned between the mold pieces

[0012] FIG. 4 is a perspective view of the underside of the male mold piece of FIG. 3;

[0013] FIG. 5 is a schematic cross-sectional view of a resin transfer molding cell suitable for use in practicing the principles of the present invention; and

[0014] FIG. 6 is an exploded view of portions of the male and female mold pieces of FIG. 5 with fibrous reinforcing material and the pre-formed insert positioned between the mold pieces.

DETAILED DESCRIPTION

[0015] Reference will now be made in detail to exemplary aspects of the present invention that are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0016] FIG. 1 is a perspective view of a boat 20 constructed in accordance with the principles of the present invention. The boat 20 includes a hull 22 including a bow 24 positioned opposite from a stern 26. A keel 28 extends between the bow 24 and the stern 26. chines 30 and strakes 27 (best shown in FIG. 2) are located on port and starboard sides of the hull 22. The boat 20 also includes a support structure 29 positioned within the hull 22. The support structure 29 includes a generally planar, horizontal platform or floor 31. The support structure 29 also includes first and second transverse supports 41 and 42. The supports 41 and 42 extend widthwise across the hull 22 and are configured for providing structural reinforcement to the hull 22. The support structure 29 further includes longitudinal stringer supports. For example, the support structure includes port and starboard stringer supports in the form of upright walls 33 that extend along the length of the hull 22 in a direction generally parallel to the keel 28. The

terms “stringer” and “support stringer” are intended to include any type of member that extends lengthwise along the hull 22 to provide longitudinal reinforcement or support to the hull 22.

[0017] Still referring to FIG. 1, the support structure 29 also defines a plurality of internal compartments. For example, the support structure 29 defines a front storage compartment 44 positioned in front of the second transverse support 42, a middle fuel-tank compartment 46 positioned between the first and second supports 41 and 42, and a rear engine compartment 48 positioned behind the first support 41. The upright walls 33 of the support structure 29 define side walls of the compartments 44, 46 and 48. For example, the upright walls 33 shown in FIG. 2 define side walls of the middle fuel tank compartment 46. The front and middle compartments 44 and 46 preferably can be covered with removable panels (not shown).

[0018] Still referring to FIG. 2, a foam chamber 53 is defined between the support structure 29 and the hull 22. The foam chamber 53 has a size and shape that corresponds to a pre-formed buoyant insert 90 (shown in FIG. 3). As shown in FIG. 2, the foam chamber 53 includes starboard and port regions 55 and 57 positioned on opposite sides of the keel 28. The starboard and port regions 55 and 57 each have generally triangular cross-sections. The hull 22, the floor 29 and the upright walls 33 cooperate to define the starboard and port regions 55 and 57 of the chamber 53.

[0019] In one particular non-limiting embodiment of the hull 22, the hull has an outer gel coat layer of about 0.024 inches, and intermediate barrier layer of about 0.035 inches, and an inner fiberglass layer of about 0.25-0.375 inches. The barrier layer prevents the fiberglass from pressing through the gel coat.

[0020] The support structure 29 and the hull 22 are preferably formed as a single, unitary or monolithic piece such that no seams or discontinuities are located between the two structures. For example, as shown in FIG. 2, adjacent the chines 30 the floor 31 merges with the hull 22 to provide a seamless connection. Similarly, the upright walls 33 (i.e., the longitudinal stringers) preferably merge with the hull 22 to provide a seamless connection. Preferably, no separate fasteners or adhesive are provided at the connection locations. Instead, the hull 22 and the support structure 29 are preferably made of a fiber reinforced plastic material, and the connection locations preferably consist of continuous, uninterrupted thicknesses of the fiber reinforced plastic material. The term “seamless” is intended to mean that the connection locations are provided by continuous, uninterrupted portions of fibrous reinforced plastic material.

[0021] Preferably, the support structure 29 and the hull 22 are simultaneously formed during a forming process such as an injection molding process or a resin transfer molding process. The phrase “resin transfer molding” is intended to include any type of molding process where a fibrous reinforcing material is positioned within a mold into which resin is subsequently introduced. U.S. application Ser. No. 08/715, 533 filed on Sep. 18, 1996 and entitled Apparatus For Molding Composite Articles, which is hereby incorporated by reference, discloses an exemplary resin transfer molding process.

[0022] An important aspect of the present invention relates to a resin transfer molding method for making a boat such as the boat 20 of FIG. 1. Generally, the method includes placing a pre-formed buoyant insert into a molding chamber. Prefer-

ably, the insert is enclosed, covered or surrounded with layers or portions of fibrous reinforcing material. Similarly, at least portions of the mold are lined with fibrous reinforcing material. The method also includes transferring resin into the molding chamber such that the resin envelops the fibrous reinforcing material. By using a pre-formed insert within the mold, the support structure 29 and hull 22 of the boat 20 can be simultaneously molded as a single piece within the molding cavity.

[0023] FIG. 3 shows a mold 50 including a set of male and female mold pieces 52 and 54 suitable for use in manufacturing a boat such as the boat of FIG. 1. The male mold piece 52 nests within the female mold piece 54. The female mold piece 52 has a top surface 56 shaped in the inverse of the bottom side of the boat 20, and the male mold piece 52 has a bottom surface 58 shaped in the inverse of the top side of the boat 20. FIG. 4 shows a schematic/simplified view of the bottom surface 58 of the male mold piece 52. As shown in FIG. 4, the male mold piece 52 includes a front projection 60 that is the inverse of the front storage compartment 44, a middle projection 62 that is the inverse of the middle-fuel tank compartment, and a rear projection 64 that is the inverse of the rear engine compartment 48. A first slot or gap 66 corresponding to the first transverse support 41 of the boat 20 is located between the rear projection 64 and the middle projection 62. A second slot or gap 68 corresponding to the second transverse support 42 of the boat 20 is located between the middle projection 62 and the front projection 60. Side walls 65 of the projections 60, 62 and 64 correspond to the upright walls 33 of the support structure 29 of the boat. A planar surface 63 corresponds to the floor 31 of the support structure 29.

[0024] FIG. 3 also shows an insert 90 suitable for use in manufacturing the boat of FIG. 1. The insert 90 is preferably made of a buoyant material (i.e., capable of floating in water) such as foam. Preferably, the insert 90 is covered, enclosed or otherwise surrounded by a fibrous reinforcing material 91. The fibrous reinforcing material can be affixed to the insert 90 (e.g., by adhesive) or loosely applied or laid about the insert 90.

[0025] Preferably, the insert 90 is pre-formed to include first and second spaced-apart elongated portions 92 and 94. The first elongated portion 92 is sized to extend along the starboard region 55 of the foam chamber 53 of the hull 22. Similarly, the second elongated portion 94 is sized to extend along the port region 57 of the foam chamber 53 of the hull 22. Each of the first and second elongated portions 92 and 94 preferably has a generally triangular transverse cross section. The elongated portions 92 and 94 also include inwardly facing surfaces 95 that face one another. The inwardly facing surfaces 95 are aligned in an upright orientation. As shown in FIG. 2, the inwardly facing surfaces 95 are configured to extend along the upright walls 33 of the support structure 29 after the boat 20 of FIG. 1 has been manufactured. Planar top surfaces 97 of the elongated portions 92 and 94 are aligned at right angles with respect to the inwardly facing surfaces 95. As shown in FIG. 2, the top surfaces 97 are positioned beneath the floor 31 after the boat 20 has been manufactured.

[0026] Still referring to FIG. 3, the first and second elongated portions 92 and 94 are interconnected by first and second spaced-apart transverse portions 96 and 98 that extend between the inwardly facing surfaces 95 of the elongated portions 92 and 94. When the boat 20 of FIG. 1 has been manufactured, the transverse portions 96 and 98 are respectively positioned within the first and second supports 41 and

42 of the boat **20** (i.e., the transverse portions **96** and **98** are encased within a fiber reinforced plastic material to provide the supports **41** and **42**). As shown in FIG. 3, the insert **90** has a two piece construction with the two pieces being interconnected by a tongue and groove type connection. However, in alternative embodiments, it will be appreciated that the insert **90** can be constructed as single piece of buoyant material.

[0027] FIG. 5 illustrates the male and female mold pieces **52** and **54** incorporated within a molding cell **70**. The cell **70** includes a substantially rigid outer support housing **72** having a bottom portion **74** and a removable top portion **76**. The male mold piece **52** is secured to the top portion **76** of the housing **72** and the female mold piece **54** is secured to the bottom portion **74** of the housing **72**. A top fluid chamber **78** is defined between the top portion **76** and the male mold piece **52** and a bottom fluid chamber **80** is defined between the bottom portion **74** and the female mold piece **54**. When the top portion **76** of the housing is mounted on the bottom portion **74** of the housing as shown in FIG. 5, a molding chamber **82** is defined between the male mold piece **52** and the female mold piece **54**.

[0028] In the embodiment of FIG. 5, the mold pieces **52** and **54** are preferably semi-rigid membranes that are capable of at least slightly flexing when pressurized resin is injected into the mold chamber **82**. In one particular embodiment, the male and female mold pieces **52** and **54** are made of sheets of metal. In other embodiments, the mold pieces **52** and **54** can be made of other materials such as fiberglass, plastic, reinforced nylon, etc. To prevent the mold pieces **52** and **54** from excessively deforming during the molding process, the top and bottom fluid chambers **78** and **80** are preferably filled with a non-compressible liquid such as water. In this regard, the top and bottom fluid chambers **78** and **80** preferably include inlets **73** for filling such chambers **78** and **80** with the non-compressible liquid. The inlets are preferably opened and closed by valves **75**. By filling the top and bottom fluid chambers **78** and **80** with non-compressible liquid and then sealing the chambers **78** and **80**, the liquid retained within the chambers **78** and **80** provides backing support to the mold pieces **52** and **54** such that deformation of the mold pieces **52** and **54** is resisted.

[0029] The cell **70** also includes structure for introducing resin into the molding chamber **82**. For example, as shown in FIG. 5, the cell **70** includes an injection sprue **86** that extends through the top portion **76** of the housing **72** for injecting resin into the molding chamber **82**. Preferably, the sprue **86** is placed in fluid communication with a source of resin **88** (e.g., a source of liquid thermoset resin) such that resin can be pumped from the source of resin **88** through the sprue **86** into the molding chamber **82**. While a single sprue **86** has been shown in FIG. 5, it will be appreciated that multiple sprues can be provided through both the top and bottom portions **76** and **74** of the support housing **72** to provide uniform resin flow throughout the molding chamber **82**.

[0030] It will be appreciated that the cell **70** can include a variety of additional structures for enhancing the molding process. For example, the cell **70** can include a heating/cooling mechanism for controlling the temperature of the fluid contained in the top and bottom fluid chambers **78** and **80**. Additionally, the top and bottom fluid chambers **78** and **80** can include closeable vents for allowing air to be bled from the fluid chambers **78** and **80** as the fluid chambers are filled with liquid. Furthermore, the molding chamber **82** can include vents for bleeding resin from the molding chamber **82** once the molding chamber **82** has been filled with resin.

[0031] To manufacture a boat using the cell **70**, the cell **70** is opened and the insert **90** of FIG. 3 is placed within the molding chamber **82**. Preferably, fibrous reinforcing material **91** is provided that surrounds or covers the insert **90**. Preferably, fibrous reinforcing material **91** is also laid below the insert **90** along the top surface **56** of the female mold **54**, and above the insert **90** along the bottom surface **58** of the male mold **52**. For example, FIG. 6 shows an exploded view of portions of the male and female mold pieces **52** and **54** with a first portion of the fibrous material **91** positioned between the insert **90** and the male mold piece **52**, and a second portion of the fibrous reinforcing material **91** positioned between the insert **90** and the female mold piece **54**. After the insert **90** and fibrous material **91** have been positioned in the cell **70**, the cell **70** is closed such that the insert and the fibrous reinforcing material **91** are enclosed within the molding chamber **82**. Thereafter, resin is injected or otherwise transmitted into the molding chamber **82** through the sprue **86**.

[0032] Prior to the resin injection process, the top and bottom fluid chambers **78** and **80** of the cell **70** are preferably filled with non-compressible liquid. The filled chambers **78** and **80** provide back support to the mold pieces **52** and **54** such that deformation of the mold pieces **52** and **54** during the pressurized resin injection process is resisted.

[0033] When the cell **70** is closed, the transverse portions **96** and **98** of the insert **90** respectively fit within the first and second gaps **66** and **68** defined by the male mold piece **52**. Additionally, the first and second elongated portions **92** and **94** of the insert **90** preferably are respectively positioned along port and starboard sides of the front, middle and rear projections **62**, **64** and **66** of the male mold piece **52**. Furthermore, the inwardly facing surfaces **95** of the insert **90** oppose the side walls **65** of the projections **60**, **62** and **64** of the male mold **52**. Moreover, the planar surface **63** of the male mold **52** opposes the planar top surfaces **97** of the insert **90**.

[0034] After the cell **70** has been closed and the backing chambers **78** and **80** have been filled with fluid, the resin is injected or otherwise transferred into the mold chamber **82**. As the resin enters the mold chamber **82**, the resin envelops and impregnates the reinforcing material **91** contained within the mold chamber **82**. Once the molding chamber **82** has been filled with resin, the resin within the chamber **82** is allowed to cure within the cell **70**. As the resin cures, the resin enveloped fibrous reinforcing material hardens to form the support structure **29** and the hull **22** of the boat of FIG. 1. For example, resin enveloped fibrous material **91** positioned along the top surface **56** of the female mold **54** hardens to form the hull **22**. Also, resin enveloped fibrous reinforcing material positioned between the inwardly facing surfaces **95** of the insert **90** and the side walls **65** of the projections **60**, **62** and **64** of the male mold **52** forms the upright side walls **33** of the support structure **29**. Additionally, resin enveloped fibrous reinforcing material positioned between the planar surface **63** of the male mold **52** and the planar top surfaces **97** of the insert **90** form the floor **31** of the support structure **29**. Moreover, resin enveloped fibrous reinforcing material surrounding the transverse portions **96** and **98** of the insert **90** form the first and second supports **41** and **42** of the support structure **29**.

[0035] By practicing the above described method, the support structure **29** and hull **22** can be simultaneously formed as a single seamless piece within the molding chamber **82**. By forming the hull and support structure **29** as a single piece, numerous process steps typically required by prior art manu-

facturing techniques can be eliminated thereby greatly enhancing manufacturing efficiency.

[0036] To enhance the aesthetic appearance of the boat, the male and female mold pieces **52** and **54** are preferably coated with a layer of gel coat prior to enclosing the insert **90** and the fibrous reinforcing material **91** within the cell **70**. Additionally, barrier coat layers are also preferably provided over the layers of gel coat for preventing the fibrous reinforcing material **91** from printing or pressing through the gel coat layers. An exemplary barrier coat layer is a layer of vinyl ester having a thickness of about 0.025 inches. Commonly, the gel coat layers can each have a thickness of about 0.020-0.024 inches.

[0037] It will be appreciated that additional structures/reinforcements can also be placed within the molding chamber **82** prior to injecting resin therein. For example, reinforcements such as plates for mounting seats, engine mount supports, and other reinforcements conventionally used in the boat manufacturing industry can be positioned at predetermined locations within the holding chamber prior to injecting resin therein. Preferably, the reinforcements are attached to the pre-formed insert **90** and positioned within the mold during the molding process. However, the reinforcements can be also be attached to the boat **20** after the hull **22** and the support structure **29** have been molded. This type of post-mold attachment procedure will typically involve milling certain locations of the boat **20** to facilitate mounting the reinforcements.

[0038] As shown in FIG. 3, the insert **90** is covered with a fibrous reinforcing material affixed to the insert **90** before the insert **90** has been placed in the cell **70**. It will be appreciated that in alternative embodiments, the insert **90** can be covered with fibrous reinforcing material by placing or laying the fibrous reinforcing material about the various features of the insert **90** within the cell **70**. Also, it will be appreciated that the various material thicknesses shown in FIG. 6 are diagrammatic (i.e., not to scale), and that in actual practice the material thicknesses can be varied at different locations within the cell to provide the resultant boat with desired strength characteristics. For example, in certain embodiments, a thicker layer of fibrous reinforcing material can be used for the portion of the hull **22** located below the water line (i.e., below the chines **30**) as compared to the portion of the hull **22** above the water line. Similarly, the thickness of fibrous reinforcing material can also be varied for the various components of the support structure **29**.

[0039] While any number of different types of resins could be used in practicing the present invention, a preferred thermoset resin is a blended polyester resin sold by Reichold Manufacturing. Additionally, the fibrous reinforcing material can include any number of different types of material such as glass, graphite, aramid, etc. Furthermore, the fibrous reinforcing material can have a chopped configuration, a continuous configuration, a sheet configuration, a random configuration, a layered configuration or an oriented configuration.

[0040] With regard to the foregoing description, it is to be understood that changes may be made in detail, especially in matters of the construction materials employed and the shape, size and arrangement of the parts without departing from the scope of the present invention. For example, it will be appre-

ciated that the various aspects of the present invention apply to resin transfer molding techniques that utilize rigid molds as well as semi-rigid molds. It is intended that the specification and depicted aspects be considered exemplary only, with a true scope and spirit of the invention being indicated by the broad meaning of the following claims.

1. (canceled)

2. A method for molding an article having an upper portion, a lower portion, and an insert located between the upper portion and the lower portion, wherein the article is molded as a single, unitary piece with no seams or discontinuities located between the upper portion and the lower portion, the method comprising:

providing a first semi-rigid membrane removably mounted to a first rigid housing to define a first fluid tight chamber therein;

providing a mold plenum defined at least in part by the first semi-rigid membrane removably mounted to the first rigid housing;

filling the first fluid tight chamber with a substantially non-compressible backing fluid to support the first semi-rigid membrane during injection of resin;

positioning the insert in the mold plenum;

providing fibrous reinforcing material within the mold plenum, the fibrous reinforcing material including portions positioned between the first semi-rigid membrane and the insert, the fibrous reinforcing material portions positioned between the first semi-rigid membrane and the insert being in contact with the insert;

injecting resin under pressure into the mold plenum such that the resin envelops the fibrous reinforcing material and the insert;

distributing a resulting injection pressure by the backing fluid; and

curing the resin by heating the backing fluid to produce the molded article.

3. The method of claim 2, wherein the molded article is a boat.

4. The method of claim 2, wherein the insert includes a buoyant material.

5. The method of claim 4, wherein the buoyant material includes foam.

6. The method of claim 2, wherein the insert includes an elongated portion including a top surface, a bottom surface, and a side surface, wherein at least one of an upper surface and a lower surface of the article is formed by portions of the resin enveloped fibrous reinforcing material that cover at least one of the top surface and the bottom surface of the insert, respectively, and an elongate support structure of the article is formed by portions of the resin enveloped fibrous reinforcing material that cover the side surface of the insert.

7. The method of claim 2, further comprising providing a finish layer within the mold plenum to form a finished outer coat on an exterior surface of at least the upper portion and the lower portion of the article.

8. The method of claim 7, wherein the finish layer includes gel coat.

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